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Should I stay or should I go?
Bank productivity and internationalization decisions

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Abstract

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Keywords: International banking; entry decisions; ordered probit; selection models
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1. Introduction

Large, internationally active banks are important channels for the integration of financial markets. But they can also contribute to the propagation of shocks across borders. [1] The importance of global banks raises a number of questions. Are banks' internationalization decisions, as for non-financial firms, determined by productivity? Which factors affect the extensive margin (the foreign investment decision) and the intensive margin (the volume of activities)? And how do banks decide on the particular mode of foreign activities (international assets, foreign branches, foreign subsidiaries)? We answer these questions using a unique dataset and extend prior literature by explicitly modeling the role played by productivity, size, risk, other bank-specific, and country-specific factors. [2]

The international trade literature shows that larger and more productive non-financial firms are more likely to export and to engage in foreign direct investment (FDI). [3] The reason is that more productive firms find it easier to pay the higher fixed and variable costs of foreign market entry compared to domestic operations (**??**). Only productive firms self-select into increasingly fixed-cost intensive foreign modes of entry because their lower variable cost due to high productivity imply additional profits from abroad.

So far, applications to international banking are rare. This paper extends existing literature on cross-border banking in three regards. First, we theoretically model the internationlization decision of banks as a function of productivity and risk. We show that, both, the decision to enter a foreign market (the extensive margin) and

[1] **?** show how the degree of internationalization of banks affects the transmission of monetary policy shocks.
[2] See, for example, **?**, **?**, **?**, **?**, or **?**.
[3] See, for example, **?**, **?**, **?**, **?**, and **?**.

the decision on the volume of activities (the intensive margin) are affected by bank productivity.

Empirically, we draw on a comprehensive dataset about the internationalization choices of *all* German banks. Most previous studies are confined to large, internationally active banks, thereby neglecting the selection of banks into foreign markets and the ensuing bias. The "External Position Report" of the Deutsche Bundesbank contains information about the international assets of all German banks, their foreign branches, and their foreign subsidiaries, year-by-year, and country-by-country. Bank risk aversion is measured by supervisory financial accounts data.

Second, we model the fixed cost of international banking by using an ordered probit model. To model self-selection of banks into the different modes of foreign activities, we enrich a conventional **?** model and include hierarchical categories in the selection equation. This method may be relevant for studies of non-financial international firms as well (**?**). We use the 2011 version of the capital account openness indicator of **?** and information on WTO bilateral trade agreements as exclusion restrictions to predict the self-selection of banks into foreign markets.

Third, we account for the endogenous relationship between banks' factor demand and productivity by using the approaches of **?** and **?**. These estimators are frequently used in non-financial firm studies, but they are rarely applied to banks. [4] We use detailed financial accounts data reported to the supervisor to estimate bank productivity. When adapting the production function estimators to banks, we exploit supervisory information about all bank exits through mergers to identify productivity.

[4] Exceptions are **?** and **?**. Most banking studies use a dual (cost function) approach (**?**). This approach neglects the bias due to the simultaneity between input choices and productivity.

Our main results are as follows. First, as regards the extensive margin of internationalization, banks and non-banks differ. In contrast to non-financial firms, many (small) banks hold international assets. In line with evidence for non-financial firms, only very few banks have foreign affiliates. Productivity is especially important for entry choices of smaller banks such as savings and cooperatives. Second, more productive banks have larger volumes of international activities. This result is not driven by size effects, and it is robust to using alternative proxies for productivity. Correcting for the selection into different foreign modes has a significant impact on the volume of activities. Consequently, studies considering only a subsample of banks to analyze internationalization are likely to suffer from selection bias. Third, banks with a higher revealed degree of risk aversion are less likely to go abroad. But, conditional on foreign presence, the volume of their activities is larger.

In Section 2, we derive theoretical hypotheses. Section 3 describes the data, the empirical model, and the measurement of bank productivity. We discuss the estimation results in Section 4, and we conclude in Section 5.

2. Theoretical hypotheses

We consider a simple, static portfolio model to analyze how bank-level productivity and the degree of risk aversion influence international banking choices. A static model allows separating more clearly the effects of productivity inspired by the goods trade literature from risk considerations central to conventional banking models, which is our focus. It comes at the expense that we do not model exit choices explicitly. Our approach amounts to the assumption that the fixed costs associated with entry *and* exit are sunk after each period. Whereas this assumption

is in line with many entry/exit choice problems (**??**), recent IO literature models market entry and exit choices as dynamic games (**??**).

We assume that banks can be active abroad either by holding foreign assets through their domestic headquarters (Mode 1) or through foreign affiliates (Mode 2).

We assume that banks invest but do not borrow abroad. [5] In each period, a representative bank chooses its optimal portfolio structure. The balance sheet restriction for bank i is:

$$W_i + D_i = L_i + L_{ij}^* + R_i, \tag{1}$$

where W_i is initial wealth, D_i are domestic deposits (liabilities), L_i are domestic loans (assets), L^* are foreign loans (assets) in country j, and R_i are risk-free assets.

The expected profit of a domestic bank i holding international assets in country j depends on the returns on domestic and international assets less variable costs and the fixed costs of foreign activities:

$$\begin{aligned}\Pi(1)_{ij} = &\left[r_L - c_{ij,L}(\omega_i)\right] L(1)_i + \left[(1-\tau_i)\, r_{j,L}^* - c_{ij,L}^*(\omega_i)\right] L(1)_{ij}^* \\ &+ r_F R(1)_i - \left[r_D - c_{ij,D}(\omega_i)\right] D(1)_i - F(1)_j,\end{aligned} \tag{2}$$

where $F(1)_j$ are the fixed costs of Mode 1, r_L and r_D are interest rates on (risky) assets and liabilities, r_F is the risk-free rate, τ_j denotes country-specific information costs that lower the return on international assets, with $0 < \tau_j < 1$, and c_{ij} are variable costs. The index (1) in this equation denotes the bank's profit function under Mode 1. The fixed and variable costs of international operations vary across host countries. The fixed costs of domestic operations are normalized to 0.

[5] Relaxing these assumptions leaves the main qualitative results of the following analysis unaffected.

In this static model, banks consider only contemporaneous profits. The upshot in dynamic structural models, such as **?** and **?**, is that agents learn about the fixed costs associated with entry and exit, and thus expected profits. Fixed costs can take different forms. They can be related to the periodical renewal of banking charters for foreign subsidiaries, or they can capture fixed costs due to allocating staff and other resources to maintaining country expertise. Fixed costs of exiting markets are not modeled because we observe hardly any retreat from a market by banks in our sample once the bank operates an affiliate in a country. In the empirical estimation below, we explicitly account for the possibility that parent banks cease to exist in the German home market by specifying exit through mergers when estimating bank productivity as in **?**.

Raising deposits and granting loans is costly. These costs reflect the resource inputs connected to handling loan applications, maintaining a branch network, and performing payment services. We assume that banks differ with regard to their productivity (ω_i) and that more productive banks incur lower costs:

$$c_{ij,\bullet} = c_{ij,\bullet}(\omega_i) \qquad \text{with } \frac{\partial c_{ij,\bullet}}{\partial \omega_i} < 0. \tag{3}$$

Each bank thus has a specific productivity level that transfers also to its foreign affiliates. The costs of supplying financial services abroad exceed those at home. Hence, $c_{ij,L}(\omega_i) < c^*_{ij,L}(\omega_i)$, holds due to the institutional and regulatory differences across financial systems and lack of familiarity with the pool of foreign borrowers. The profits of a bank that establishes foreign affiliates (Mode 2) are then:

$$\begin{aligned}\Pi(2)_{ij} = &\left[r_L - c_{ij,L}(\omega_i)\right] L(2)_i + \left[r^*_{j,L} - c^*_{ij,L}(\omega_i)\right] L(2)^*_{ij} \\ &+ r_F R(2)_i - \left[r_D - c_{ij,D}(\omega_i)\right] D(2)_i - F(2)_j\end{aligned} \tag{4}$$

This specification is similar to Equation (2) with two exceptions. First, we assume that the fixed costs of operating under Mode 2 are higher than the fixed costs of Mode 1, $F(1)_j < F(2)_j$ (**?**). Intuitively, the fixed cost associated with (re-)applying for a banking charter for a foreign affiliate are likely larger compared to those associated with operating a country desk for cross-border lending activities.

Second, information costs are lower under Mode 2, because the bank is operating in a foreign country. We treat information cost in banking as the analogue of melting iceberg transportation cost in the trade literature. This approach is in line with theoretical and empirical banking literature that emphasizes two traits of information generation cost in banking. Greater geographical distance between banks and customers implies higher cost of acquiring and generating private information (**??**). Moreover, information generation technology is directly related to bank productivity and, hence, marginal cost and profits (**???**). Without loss of generality, we set these costs to zero for Mode 2. Our specification thus involves a trade-off between the fixed and variable costs of foreign activities, similar to that in the trade literature.

The main difference between banks and non-financial firms is that banks care about the risk of their activities. We follow **?** and assume an objective function that increases with expected profits and decreases with risk: [6]

$$U = U\left[E(\Pi_{ij}), \sigma^2\left(\Pi_{ij}\right)\right], \frac{\partial U}{\partial E(\Pi_{ij})} > 0, \frac{\partial U}{\partial \sigma^2\left(\Pi_{ij}\right)} < 0 \tag{5}$$

Under the simplifying assumption that deposits carry no risk, the variance of the portfolio is $\sigma^2(\Pi_{ij}) = L_i^2\sigma^2 + L_i^{*2}\sigma^{*2} + 2 \times L_i L_{ij}^* COV_j$, where $\sigma^2(\sigma_j^{*2})$ is the country-specific risk of domestic (foreign) assets, and COV_j is the covariance matrix of

[6] Empirically, we gauge different aspects of bank risk with so-called CAMEL-covariates, which is short for capitalization, asset quality, management quality, earnings, and liquidity.

domestic and foreign returns.

We use this model to analyze the intensive and extensive margins of banks' foreign activities. For the extensive margin, the bank chooses to be active in the foreign country if its expected utility is positive, that is, if $U > 0$ holds. Using Equations (3)–(5), one can show that the probability of investing abroad is higher with lower fixed costs of foreign activity (F_j), lower information costs (τ_j), higher bank productivity (ω_j), and lower risk of foreign activities (σ_j^{*2}). Banks prefer Mode 2 over Mode 1 if their productivity exceeds a threshold ($\bar{\omega}$) and if the savings in the fixed costs associated with entering through Mode 2 are small relative to the higher variable costs under Mode 1. Thus, banks with $\omega_i < \bar{\omega}$ choose Mode 1, but banks with $\omega_i > \bar{\omega}$ choose Mode 2 and maintain affiliates abroad.

We analyze the volume of international activities, the intensive margin, by differentiating the objective function with respect to international risky assets (L_{ij}^*): [7]

$$\begin{aligned} \frac{\partial U}{\partial L_{ij}^*} &= \frac{\partial U}{\partial E(\Pi_{ij})}\left[(1-\tau_i)\, r_{j,L}^* - c_{ij,L}^*(\omega_i)\right] \\ &+ \frac{\partial U}{\partial \sigma^2\left(\Pi_{ij}\right)}\left[L_{ij}^{*2}\sigma_j^{*2} + L_i COV_j\right] = 0. \end{aligned} \tag{6}$$

We denote the degree of the banks' risk aversion as $\lambda_i = -\frac{1}{2}\frac{\partial U}{\partial E(\Pi_{ij})} + \frac{\partial U}{\partial \sigma^2\left(\Pi_{ij}\right)} > 0$ and rewrite the first-order condition from Equation (6) as

$$\frac{\partial U}{\partial L_{ij}^*} = \frac{\partial U}{\partial E(\Pi_{ij})}\left\{\left[(1-\tau_i)\, r_{j,L}^* - c_{ij,L}^*(\omega_i)\right] + \frac{1}{\lambda_i}\left[L_{ij}^{*2}\sigma_j^{*2} + L_i COV_j\right]\right\} = 0. \tag{7}$$

With Equation (7), it is straightforward to show that banks will increase the volume of their international assets when they experience higher gross returns (r_L^*), lower

[7] We omit indices because results are qualitatively identical across different modes.

information costs (τ_j), higher productivity and thus lower variable costs ($c^*_{ij,L}(\omega_i)$), lower risk (σ^{*2}_j), lower correlations between domestic and foreign returns (lower COV_j), and lower degrees of risk aversion (λ_i). Table 1 summarizes the results of the comparative static. [8]

– Insert Table 1 around here. –

3. Data and empirical methodology

Bringing the above theoretical considerations to the data and testing in particular whether banks' international expansion strategies are driven by productivity and risk aversion, requires detailed data. This section describes how we model the internationalization of banks, their bank-specific characteristics, and the features of foreign markets as potential investment locations.

3.1. Data about bank internationalization

We analyze the patterns of bank internationalization using a unique and detailed database on banks' international assets, the so-called External Position Report filed by Deutsche Bundesbank (**?**). The dataset provides comprehensive information about the international assets of domestic banks, their foreign branches, and their foreign subsidiaries, year-by-year and country-by-country. We study the database for the pre-crisis years 2002–2006. We deliberately choose 2006 as the end point of our sample because we do not want our results to be affected by adjustment during

[8] The assumption that a bank transfers its productivity abroad may seem at odds with the evidence in **?**, who show that foreign banks are less efficient than domestic banks. The optimization in our model entails a comparison among domestic banks at home regarding their choice to go abroad and not between domestic and foreign banks abroad.

the crisis. The start of our sample is January 2002, which is when reporting thresholds for international assets were abolished. Therefore, we have exact information about the extensive and intensive margin of banks' foreign operations, and we do not face any problems related to truncation or censoring.

To obtain information about the extensive margin of banks' foreign operations, we manually link branches and subsidiaries located in country j to their domestic parent bank i. To obtain information on the intensive margin, we aggregate all assets held in country j across the different modes of foreign activity. We use aggregate foreign asset and do not distinguish between different types of assets to keep the analysis tractable. Most of the assets we include are interbank assets. We also complement the External Position Report with information from the annual balance sheets and income statements of all banks operating in Germany between 2000 and 2006.[9] Each bank that holds a German banking license must submit these data to the supervisory authorities.

We complement these proprietary data with publicly available macro data, which are described in Appendix B. The unbalanced panel contains observations for each bank ($i = 2,226$), each destination country ($j = 35$), and each year ($t = 5$).

In terms of country coverage, our data include members of the Organization for Economic Cooperation and Development (OECD) as well as non-OECD countries and yields a comprehensive picture of German banks' foreign activities.[10] We distinguish four modes of operation: (i) purely domestic banks without foreign activities (Mode 0), (ii) banks that hold international assets through their domestic

[9] We use bank-level data back to 2000 because we require lagged information to estimate productivity.

[10] All banks with a German banking license have to report these data. We observe 2,235 banks that report at least total assets to the Bundesbank. We exclude nine banks from the sample because of missing data. These are all small banks with no international activities.

headquarters (Mode 1), (iii) banks that maintain foreign branches (Mode 2a), and (iv) banks that maintain foreign subsidiaries and/or foreign branches (Mode 2b).

Each bank-year-country observation is included in only one mode. The modes are therefore mutually exclusive. The ranking of modes follows the fixed costs involved: Subsidiaries are legally independent, hold their own equity, and are subject to host-country control, so they demand the highest capital costs and regulatory burden. In addition, they often enable large-scale retail operations, which implies fixed costs over and above the regulatory start-up costs (**?**).

– Insert Table 2 around here. –

Table 2 and Figure 1 highlight four main characteristics of the internationalization patterns of German banks: First, observations are very dispersed across modes of internationalization with many zeros (73%) in the bilateral matrix (Columns 1 and 3 of Table 2). Approximately 27% of the observations are in the category of international assets. Only a few banks have foreign affiliates. Hence, the number of observations in Modes 2a and 2b (affiliates) is tiny, accounting for less than 1% of the total. [11]

Second, because we treat each bank in each country as a separate observation, the data are inflated. Determining whether a particular bank is active abroad produces quite a different picture (Columns 3 and 4 of Table 1). On average, only 19 of a total of 2,226 banks are purely domestic, 27 maintain foreign branches, and 37 use subsidiaries and/or branches. The largest group by far consists of banks that hold international assets in at least one foreign country (2,143). This is in contrast

[11] Sparse bilateral trade matrices are common also in non-banking studies and are not per se an econometric problem. One concern could be a poor discriminatory power of the selection equation. But pseudo-R^2 (Table 6) and unreported areas under the receiver operating characteristics curve are fairly high in our sample.

to manufacturing firms, of which only a small subset of firms export or import.

Third, even the large banks with international affiliates operate in only a very few countries (Table 2, Column 5). German banks have branches in an average of only 1.4 countries. Banks with subsidiaries are on average active in 3 countries.

– Insert Figure 1 around here. –

Fourth, in terms of the volume of international assets (the intensive margin), those held through domestic banks (Mode 1) and those held through foreign branches (Mode 2a) are of almost similar importance (Figure 1). The share of international assets held in foreign subsidiaries (Mode 2b) is small. The patterns in the data are similar for mean investments. Comparing the mean and median investment in each mode reveals a substantial degree of heterogeneity across banks. In Mode 1 (international assets), for example, the mean investment is €8.6 million, though the median is only €0.14 million. This shows that the data are driven by a few, large players.

In sum, the data paint a nuanced picture of German bank internationalization. Many banks hold international assets in at least one foreign country. But only few have foreign affiliates, and these banks dominate the aggregate numbers.

3.2. Estimation method

With the data at hand, we can now model the internationalization of banks using a self-selection model in the spirit of **?**. Similar to **?**, we replace the conventional selection equation with an ordered probit model to account for the hierarchy of modes of activities. The extensive margin (EM) reflects the discrete decision of banks whether and through which mode to be present in a foreign market. Condi-

tional on foreign presence, the bank chooses then the volume of foreign activity, the intensive margin (*IM*). Our model of bank i's operation in country j in year t takes the following form:

$$EM_{ijt} = \alpha X_{ijt} + \beta Z_{ijt} + v_{ijt} \tag{8a}$$

$$IM_{ijt} = \gamma X_{ijt} + \sigma_{IM} u_{ijt}, \tag{8b}$$

where σ_{IM} is the standard error of the intensive margin's error term and Z is a vector of exclusion restrictions to identify the extensive and the intensive margin (**?**). The error terms u and v are assumed to follow a standard bivariate normal distribution with mean zero, unit variance, and correlation ρ. [12] Errors are independent from the covariates X and Z. Covariates in X capture productivity, other bank-level variables, and host country-specific variables. Because we can observe the intensive margin only if $EM_{int} > 0$, and because the error terms are correlated, the ordinary least square (OLS) estimates of γ would suffer from a selection bias.

We model the extensive margin as an ordered probit model, which yields consistent coefficient estimates of α and β, as well as threshold values μ_1, μ_2, and μ_3, which separate the categories. The probability that a bank self-selects into one of four mutually exclusive ordinally scaled modes is given by:

$$\begin{aligned}
Pr\left(EM_{ijt} = 0|Z_{ijt}\right) &= \Phi\left(\mu_1 - \beta Z_{ijt}\right) \\
Pr\left(EM_{ijt} = 1|Z_{ijt}\right) &= \Phi\left(\mu_{2a} - \beta Z_{ijt}\right) - \Phi\left(\mu_{1a} - \beta Z_{ijt}\right) \\
Pr\left(EM_{ijt} = 2a|Z_{ijt}\right) &= \Phi\left(\mu_{2b} - \beta Z_{ijt}\right) - \Phi\left(\mu_{2a} - \beta Z_{ijt}\right) \\
Pr\left(EM_{ijt} = 2b|Z_{ijt}\right) &= 1 - \Phi\left(\mu_{2b} - \beta Z_{ijt}\right)
\end{aligned} \tag{9}$$

For the probabilities to be positive, $\mu_1 < \mu_{2a} < \mu_{2b}$ must hold. Thresholds can be

[12] This specification allows applying a standard normal distribution in the correction term, drawing on **?**.

interpreted as proxies for the fixed costs of foreign activity that banks must cover. To estimate the determinants of the intensive margin, we account for the bias induced by the selection of banks into the different modes by taking the conditional expectations of the intensive margin:

$$E\left(IM_{ijt}|Z_{ijt}, EM_{ijt}=k\right)=\alpha X_{ijt}+\sigma_{IM}E\left[u_{ijt}|Z_{ijt}, EM_{ijt}=k\right], \tag{10}$$

where $k=1,2a,2b$. Assuming correlated errors across modes, we can simplify the conditional expectations of the error term in Equation (10) to

$$E\left(\rho v_{ijt}|Z_{ijt}, EM_{ijt}=k\right)=\rho E\left[v_{ijt}|\mu_k-\beta Z_{ijt}<v_{ijt}<\mu_{k+1}-\beta Z_{ijt}\right], \tag{11}$$

which resembles the inverse Mills ratio in a standard Heckman model. [13] We replace the conventional selection equation by an ordered probit model. The corresponding correction term λ_{ijt}^{k}, therefore, depends on the mode chosen by bank i. The intensive margin then transforms into:

$$E\left(IM_{ijt}|Z_{ijt}, EM_{ijt}=k\right)=\alpha X_{ijt}+\sigma_{IM}\rho\lambda_{ijt}^{k}, \tag{12}$$

with

$$\begin{aligned}
\lambda_{ijt}^{1} &= \frac{\phi\left(\mu_1-\beta Z_{ijt}\right)-\phi\left(\mu_{2a}-\beta Z_{ijt}\right)}{\Phi\left(\mu_{2a}-\beta Z_{ijt}\right)-\Phi\left(\mu_1-\beta Z_{ijt}\right)} && if\, EM_{ijt}=1\\
\lambda_{ijt}^{2a} &= \frac{\phi\left(\mu_{2a}-\beta Z_{ijt}\right)-\phi\left(\mu_{2b}-\beta Z_{ijt}\right)}{\Phi\left(\mu_{2b}-\beta Z_{ijt}\right)-\Phi\left(\mu_{2a}-\beta Z_{ijt}\right)} && if\, EM_{ijt}=2a\\
\lambda_{ijt}^{2b} &= \frac{\phi\left(\mu_{2b}-\beta Z_{ijt}\right)}{1-\Phi\left(\mu_{2b}-\beta Z_{ijt}\right)} && if\, EM_{ijt}=2b
\end{aligned}$$

The correction term specified in Equation (12) performs a function analogous to

[13] See Appendix A for details.

that of the inverse Mills ratio in a conventional sample selection model (**?**). Neglecting this term leads to an omitted variable bias, following from the assumption that u and v in Equations (8a) and (8b) are not independent but bivariate normally distributed. The hierarchical modeling of the extensive margin, therefore, contains information that affects the estimation of the intensive margin.

3.3. Measuring bank productivity

To obtain an unbiased measure of bank-level productivity (ω_{it}), we follow the non-financial firm literature on productivity and use the estimators of **?** and **?**. Bank i's output Y at time t is measured by total lending. Loans are generated by using fixed capital K and labor X_1 as in **?**, **?**, and **?**. In addition, we specify borrowed funds X_2.[14] The production function is

$$\ln Y_{it} = \mathbf{a} + \mathbf{b}\ln \mathbf{X_{1it}} + \mathbf{c}\ln \mathbf{X_{2it}} + \mathbf{d}\ln \mathbf{K_{it}} + \ln \omega_{\mathbf{it}} + \varepsilon_{\mathbf{it}}. \tag{13}$$

where ω_{it} is (unobservable) productivity, and ε_{it} are error terms reflecting shocks. Factor demand for $X_{1,2}$ is variable, i.e. the bank can adjust labor and borrowed funds after a negative output shock if, for example, loan demand collapses. Fixed capital K is the observed state variable.

The challenge in obtaining unbiased estimates of ω follows from the simultaneity of productivity and factor demand. The estimators of **?** and **?** resolve this issue by noting that unobservable productivity can be expressed as a function of contemporaneous and lagged state variables and intermediate inputs. We specify equity

[14] The definition of banks' intermediation technologies remains a matter of ongoing debate (**?**). **?** show that the specification of alternative outputs, such as total earning assets or deposits, and inputs bears little differences for productivity estimates for a sample of German banks.

capital as the intermediate input used by banks. As argued by **?**, this method avoids the violation of the (often implicit) independence assumption between productivity and the factor input choices of banks.

The estimator of **?** furthermore exploits information of firm exit to identify firm-specific productivity. In contrast to non-financial firms, banks usually do not exit through insolvencies. The reason are potential negative externalities, such as bank runs (**?**). But ongoing mergers among German banks over the last 20 years show the consolidation in the German banking industry (**?**). Therefore, we prefer this estimator and model exits through mergers and takeovers based on data obtained from prudential supervisory reports for all German banks.

– Insert Table 3 around here. –

In Table 3, we report the parameter estimates for the production functions and summarize the variables used. For comparison, we also show OLS estimates of Equation (13). Parameter estimates resemble those reported by **?** for Brazilian banks and **?** for German savings banks. OLS regressions highlight the severe bias in parameters when we neglect the simultaneity of production choices and bank productivity. The OLS intercept can be interpreted as a Solow productivity residual. Because the estimate of productivity (ω_i) is bank-specific, the results for the **?** (OP) and the **?** (LP) estimators lack this entry. [15] In addition to productivity estimates based on Equation (13), we also specify a plain measure of labor productivity as the number of full-time equivalents per million of Euros of total assets as MPL.

– Insert Table 4 around here. –

Table 4 describes bank productivity and bank-level covariates for the different

[15] We do not report the parameter estimate of the intermediate input (equity) in the OP and LP specifications. Equity is an ancillary parameter, required only to obtain unbiased estimates of productivity.

modes of internationalization. CAMEL variables exhibit a clear pattern. More complex and more costly modes of international operations are associated with a lower degree of capitalization, lower reserve holdings, lower loan-loss provisions, lower cost-to-income ratios, lower return on equity, and lower liquidity. These results are in line with our theoretical priors that more productive banks are more likely to be active internationally and choose more complex modes. Banks with a lower revealed degree of risk aversion are more active internationally as well.

4. Results

Next, we analyze the likelihood that banks operate abroad in different modes (cross-border assets, branches, or subsidiaries) as a function of bank productivity.

4.1. Identification

Estimation of Equation (8a) requires specifying macroeconomic conditions X in country j. We also need to find variables that affect the entry of banks into specific markets but not the volume of investment, i.e. variables that can serve as exclusion restrictions Z. Adequate exclusion restrictions explain the probability of bank i's presence in country j at time t but are uncorrelated with the volume of international activities. Natural candidates for such exclusion restrictions are restrictions on capital account (CA) transactions and restrictions on international trade. Table 5 summarizes the data.

– Insert Table 5 around here. –

Information on capital account openness can be obtained for each country j from (**?**) in the version of the year 2011. The capital ccount index is an aggregate index

which is coded such that larger values indicate more open capital accounts. It is based on five different capital account items: equity transactions, money market instruments, bonds, collective investment instruments and institutions [*** Was ist das ? ***], foreign direct investment, and commercial bank presence. The index is based on the "Annual Reports on Exchange Arrangements and Exchange Restrictions (AREAER)" by the International Monetary Fund (IMF). Whereas more open capital accounts receive larger index values, a value of "one" for individual components indicates that restrictions on capital account transactions are in place.

To account for the fact that the internationalization of banks and non-banks are closely related, we use information on whether a given country has a free trade agreement with the European Union, and thus with Germany. Such an agreement should ease the entry cost for non-financial firms, thereby increasing the likelihood that banks follow their customers by some mode of internationalization. The existence of such agreements is exogenous to the individual bank, but is likely to affect its entry choice.

Table 6 shows regression results for the extensive margin in Equation (8a) when specifying aggregate indices and individual components separately and jointly. All regressions include banking group and time fixed effects. Standard errors are clustered at the bank-country level. All variables except the dummy variables and those expressed in percentages are in logs and are lagged by one period.

– Insert Table 6 around here. –

To put coefficient estimates into perspective, Table 7 provides elasticities for the extensive margin. Because we use an ordered response model with discrete outcomes to model the extensive margin, the marginal effects differ across modes and indicate the extent of change in the probability of choosing one distinct mode

in reaction to a change in a particular explanatory variable (at the mean).

– Insert Table 7 around here. –

Regression results confirm that our exclusion restrictions jointly explain entry choices quite well, and are thus valid. Banks are more likely to be active in countries with a WTO free trade agreement and in countries with a more open capital account as indicated by the Chinn-Ito index. Note that the index also contains capital account restrictions regarding commercial banking, which would therefore violate the independence requirement for valid exclusion restrictions by construction. Therefore, we consider individual CA indicators jointly in column (5) except those concerning commercial banking. Recall that a value of "one" indicates that CA restrictions are in place with country j at time t. The index components for indicators measuring ease of access to debt instruments (money market, bond market, collective investment) carry a negative coefficient. Equity-related components (equity, FDI) exhibit positive coefficients. This is reminiscent of a substitution effect as equity capital maybe replaced by debt in these countries.

4.2. Baseline regression results

Bank productivity measured has a positive impact on banks' selection into foreign markets. This positive productivity effect is largely independent from the way we measure capital and trade openness or which additional controls to include. The positive impact of bank productivity is confirmed by results using alternative measures of bank productivity such as those suggested by Olley-Pakes (OP), Levinsohn-Petrin (LP), or a simple measure of labor productivity (MPL). Our preferred specification is the one using OP estimate because it explicitly relies on parent bank exits due to mergers among German banks. In each case, the exclusion

restrictions are individually and jointly highly significant. The explanatory power of the ordered probit model is quite high with a pseudo-R^2 of 40% in Table 6. [16]

Results reported in Tables 6 and 7 confirm that more complex, fixed-cost intensive modes of bank internationalization require higher productivity. There are four aspects of our empirical results confirming this conclusion.

First, all cut-offs μ for the extensive margin are significantly different from zero, indicating a hierarchy of internationalization modes. Higher fixed costs of more complex activities abroad appear in the higher cut-off values. Simple t-tests show that the cut-offs differ significantly.

Second, the estimated cut-offs increase more in absolute terms when we move from Mode 1 to Mode 2a compared with the move from Mode 2a to Mode 2b. Considering the interval length relative to a particular coefficient such as the one for productivity $(\mu_{k+1} - \mu_k)/\alpha_\omega$, productivity must increase significantly for a bank to reach the next category. Opening a subsidiary does not require much higher productivity as the bank already maintains a branch in a specific country (transition from Mode 2a to 2b). The additionally required productivity is considerably higher if the bank moves from Mode 1 (international assets held domestically) to Modes 2a or 2b (foreign affiliates): $(\mu_{2a} - \mu_1)/\alpha_\omega > (\mu_{2b} - \mu_{2a})/\alpha_\omega$.

Third, the correction term in the outcome equation shown is statistically significant (Table 8), and it does not matter how we measure the intensive margin (log levels or shares in total assets). Therefore, neglecting selection into a particular mode of internationalization generates a significant bias. This result is important

[16] Even for the sparsely populated modes 2a and 2b, individual discrete models shows areas under the receiver operating characteristics curve of around 75%, i.e. a good ability of the discrete model to discriminate events and non-events correctly. The explanatory power for the intensive margin is of a similar magnitude with R^2 of around 35%.

because most previous studies focus on internationally active banks only.

– Insert Table 8 around here. –

Fourth, productivity has a positive and significant impact. This result is robust to adding other bank-level variables related to productivity such as size or return on equity. The result that larger and more profitable banks expand abroad is in line with prior literature pertaining to international banking.

**** Die folgenden beiden Abstze habe ich aus dem Schreiben an den Referee genommen. Bitte prfen. ****

To interpret our results, note that the variable controlling for the size of the parent bank is a quintile indicator in the spirit of Aviat and Coeurdacier (2007), and it captures the volume of domestic operations of the parent bank. Hence, we explain the (absolute) volume of foreign activity while explicitly controlling for the correlation between size and productivity of the domestic bank.

To account for the fact that normalization may matter, we re-estimate the model using two additional dependent variables: Table 8 also specifies the share of foreign assets in country j as a share of gross domestic total assets as well as the share of foreign assets in country j of total foreign assets as dependent variables in the outcome equation. The first of these ratios is a measure of the degree of internationalization, the second is a proxy for the composition of the foreign portfolio. We find that productivity affects the volume of foreign activities but not the share of these activities relative to domestic or foreign assets. One explanation is that the size dummies pick up productivity effects and that the model is over-specified if we use a scaled dependent variable and include both, size and productivity. Size, in contrast, has a significant impact on all measures of internationalization: larger banks have larger volumes of foreign assets, larger volumes relative to total assets,

and smaller shares in each foreign country (i.e. more diversified portfolios).

*** Ende Einschub ***

4.2.1. Does risk aversion matter?

We also investigate whether banks' risk aversion affects internationalization choices. Risk aversion cannot be observed directly. But the CAMEL profile contains four indirect measures of bank risk: Banks with a low degree of capitalization, low hidden reserves, high non-performing loans, and low loan-loss provisions have higher levels of risk which would reflect, ceteris paribus, a lower degree of risk aversion.

Our results confirm that risk aversion is important. Banks that are willing to take on higher risks are more likely to be active internationally. The signs for capitalization and reserves are negative and significant for the extensive margin. The picture changes for the intensive margin. The positive signs for loan-loss provisions and the negative sign for non-performing loans suggest less risk-averse (more stable) banks to do more business. Overall, our results indicate that the decision to venture abroad is positively affected by a low degree of risk aversion. Once being active abroad, less risky banks generate higher business volumes.

Various dummy variables are included to capture heterogeneity across banks in terms of banking groups and locations. An indicator variable for banks located in East Germany accounts for the lower degree of international integration of this region compared with the German average. Banks headquartered in East Germany are significantly less active in international markets. Given that a bank located in the East has invested abroad, the volume of activity is above average. A possible explanation could be the follow-your customer motive: because only a few East

German banks are active internationally, the demand for banking services from home country clients is concentrated on these banks.

Throughout, we include banking group dummies to distinguish large banks, commercial banks, and savings banks from cooperative banks, as the omitted category. These dummies are significant but are not reported to conserve on space. Large, commercial banks are more likely to go abroad and to hold more foreign assets than cooperative banks. Savings banks are less likely to do go and hold large volumes.

4.2.2. Foreign market size

Countries with larger and more developed markets are more attractive destinations for international banks, so we expect a positive sign for market size and gross domestic product (GDP) per capita. We also include total German FDI as a proxy for real integration and the demand for financial services by German firms abroad, which we anticipate will have a positive impact.

We consistently find a positive impact of market size on the extensive margin. GDP, GDP per capita, and German FDI are positive and significant. The effects of GDP per capita and German FDI are positive and significant for the intensive margin as well. The volume of foreign assets correlates negatively with market size (GDP), because we control for the volume of FDI. If we drop FDI, we estimate a positive and significant coefficient. In this sense, our results confirm studies that indicate a link between trade and financial integration (**??**).

4.2.3. Information cost

For international banks, the costs of gathering information are important. In the international finance literature, geographical distance between two countries is often used to proxy for such information costs (**??**). Providing financial services to more distant markets or setting up distant foreign affiliates is more costly than doing business in nearby markets. Distance yields the expected negative sign for the extensive margin. **** Der folgende Satz komme sehr unvermittelt. Besser erklren oder streichen **** When distance increases by 1%, GDP increases by 2.4% ($-\hat{\beta}_{Dist}/\hat{\beta}_{GDP}$) for a bank that chooses the same mode of entry. Regarding the intensive margin, distance has the expected negative impact as well.

As an additional proxy of information costs, we specify a composite index for the level of institutional quality (**??**). A higher value indicates better institutional quality. We expect a positive sign, which is confirmed for the extensive and the intensive margin.

International trade (or banking) literature using bilateral data often includes additional dummies, such as the presence of a common border or a common language. We do not include such variables because we use information for only one source country of international assets. Language or border dummies would thus be collinear with country fixed effects or geographic distance.

4.2.4. Macroeconomic portfolio effects

To account for portfolio effects, we use the standard deviation of GDP growth (growth volatility) in each host country j, computed over the past five years. [17] We

[17] We compute growth volatility and growth correlations on the basis of residual GDP growth, regressed on a full set of time-fixed effects, to account for general macroeconomic developments that may influence GDP growth.

expect a negative sign. To measure the correlation between domestic and foreign returns, we use the growth correlation of German and foreign GDP growth rates for rolling windows of five-year periods. We expect a negative sign as well, because higher correlations imply less potential for diversification. A dummy for countries in the Euro area provides a proxy of the (absence of) exchange rate risk.

Our results support previous studies in the sense that we find a positive impact of correlation on the intensive margin. This "correlation puzzle" is also reported by **?** for equity markets and **?** for international banking. Volatility, in turn, reduces the likelihood of foreign activities but it has has no significant influence on the volume of these activities abroad.

4.2.5. Fixed costs of foreign activity

As a first proxy for the fixed costs of foreign activities, we include a measure for activity restrictions faced by banks. This is a discrete measure which indicates restrictions on services and products that banks are allowed to offer and restrictions on non-financial firm ownership and control (**?**). We expect a negative sign because tighter activity restrictions deter foreign activity. More stringent capital regulations should have a qualitatively similar negative effect.

Tighter activity restrictions and capital regulations have the expected negative impact on the extensive margin. The impact of regulatory restrictions on the volume of activities is positive: Banks that entered a particular foreign market have a larger volume of activities there. This positive effect is driven by the group of large banks. For other banking groups, activity and capital restrictions have a negative impact on entry probabilities and the volume of activities whenever they are significantly different from zero.

At the country-level, we also control for banking market concentration. We find no significant impact on entry but a negative effect on volumes of activity. Controlling for other country-specific features, an offshore dummy yields a negative sign, a result which is driven by the cooperative banks. For the other banking groups, the offshore dummy has the expected positive sign.

4.3. Robustness

We perform several robustness tests. Results consistently confirm the impact of productivity on international banking: The estimated cut-offs are significant, the interval length relative to the productivity coefficient declines for more complex modes of activities, and productivity and size have positive and significant impacts.

We test the robustness of our results in six steps.

First, we estimate the model year-by-year, and the result concerning productivity remain intact.

Second, instead of clustering at the bank-country level, we cluster the standard errors at the bank and country level separately and we then bootstrap standard errors to consider productivity as a generated regressor. The findings are robust to these variations.

Third, when estimating a bank-country fixed effects panel for the intensive margin, bank productivity is insignificant. This is due to relatively little within-sample variation in bank productivity left, which is picked up by the fixed effects. The results for size and the correction term do not change.

Fourth, we conduct the test suggested by **?** to account for endogenous regressors in the outcome equation as well as heterogeneously distributed and serially

dependent error terms in the selection and outcome equation. For this purpose, we estimate the extensive margin year-by-year and add time averages of the bank-level variables. We compute the correction terms separately for each year and include them in the intensive margin equation. The productivity, core bank-level, and macro-level covariates preserve their significance, and results are qualitatively identical to those reported previously.

Fifth, pooling across countries at different stages of development might affect our results. Therefore, we re-estimate the model for OECD countries only. The main results for the bank-level variables are similar.

Finally, our focus on productivity and risk may ignore that smaller (savings and cooperative) banks are not as active internationally, despite being potentially very productive. Such a pattern could result from legal barriers to operate abroad or because these banks have access to international markets through their head institutions (e.g., the Landesbanken for savings banks). We thus split the sample into different banking groups: large, commercial, savings, and cooperative banks.

– Insert Table 9 around here. –

Productivity has a similar qualitative effect for small and large banks (Table 9). But an increase in productivity has a much greater impact on both extensive and intensive margins for smaller than for larger banks. Productivity has no significant impact only for smaller commercial banks. This group includes private banks that often focus on specific segments of the German domestic banking market.

With regard to the risk results, smaller banks might be different because, for example, savings banks are government-owned and subject to implicit and explicit guarantees. Table 9 does not indicate that the degree of risk aversion of government and privately owned banks exerts a systematically different impact on internation-

alization patterns. If anything, more risk-averse, large banks are more likely to enter foreign markets, though they engage in lower volumes of activities.

5. Conclusion

The impact of size and productivity on the internationalization of non-financial firms is a stylized fact in international economics. We study the impact of size and productivity for bank internationalization. We use a novel, bank-level dataset with detailed information about the location, mode, and the volume of banks' foreign activities. We distinguish purely domestic banks, banks that hold international assets, banks with foreign branches, and banks with foreign subsidiaries.

We model the internationalization decision of banks in a two-step empirical model. First, we estimate bank-level productivity by applying the models of **?** and **?** to the banking industry. Second, we model the extensive and intensive margins of foreign activity with a selection models enriched by an ordered probit model to account explicitly for the hierarchy of different foreign activity modes.

Our results reveal similarities between the internationalization patterns of banks and non-financial firms. In terms of bank-level determinants of internationalization, only the largest banks set up foreign affiliates. More costly modes of internationalization require higher productivity. Productivity affects selection into foreign status which, in turn, has a significant impact on the volume of international bank activities.

In terms of country-level determinants of internationalization, gravity variables are important for banks just as they are for non-financial firms. Greater distances discourage international banking, larger and more developed markets promote in-

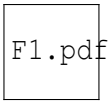
ternational banking, and activity restrictions deter banks. Taken together, our results show that policies affecting foreign entry will have a disproportionately large effect on the volumes of international banking activities.

We also highlight two noteworthy differences between international banking and non-financial firms. First, bank-level risk factors affect bank internationalization. More risk-averse banks are less likely to expand abroad, and they have larger volumes of activities. Second, smaller banks typically hold foreign assets in at least one market whereas small, non-financial firms tend to be purely domestically oriented. This suggests lower fixed costs of holding international assets compared with selling or sourcing abroad.

References

6. Figures

Fig. 1. Volumes of investment



7. Tables

Table 1
Theoretical predictions and measurement

		Expected Signs		
Parameter	Measurement	Extensive margin	Intensive margin	Mode 2 > Mode 1?
	Bank level			
Bank productivity ω_i	Productivity, cost-to-income ratio, return on equity, size	+	+	+
Bank risk aversion λ_i	High risk aversion: Capitalization, reserves, loan-loss provisions	–	–	–
	Low risk aversion: Non-performing loans	–	–	–
	Country level			
Fixed costs of foreign activity $F_j()$	Activity restrictions, capital restrictions	–	0	–
Expected returns r_L^*	GDP, GDP per capita, German FDI	+	+	+
Information costs τ_j	Distance, institutional quality	–	–	+
Country risk σ_j^*	GDP growth volatility	–	–	–
Return correlations	Correlation between domestic and foreign GDP growth	–	–	–

Notes: The column labelled *Extensive margin* indicates expected signs for the parameters discussed in Section 2 for the likelihood of operating in foreign banking markets. The column labelled *Intensive margin* indicates the expected effects on the volume of foreign assets conditional on foreign presence. The column labelled *Mode 2 > Mode 1* indicates the expectation of the parameter effect to be larger for foreign presence via affiliates compared to cross-border activity.

Table 2
Modes of internationalization

Mode	Description	(1) Number of bank-year-country observations	(2) %	(3) Number of banks	(4) %	(5) Average number of foreign countries
0	No foreign activity	249,410	72.55	19	0.85	0
1	International assets	93,684	27.25	2,143	96.27	14
2a	Foreign branches	447	0.13	27	1.21	1.41
2b	Foreign subsidiaries	229	0.07	37	1.66	3.05

Notes: Data are based on the full dataset of 2,226 banks, 35 countries, and 5 years (2002–2006). Columns 1 and 2 reflect the full, expanded dataset using all bank-country-year combinations, Columns 3 and 4 use the dataset collapsed by banks. Column 5 shows the average number of countries in which banks in each mode are active. Mode 0 indicates that there are no activities of bank i in country j in year t.

Table 3
Bank production function estimates

Variable		Estimator				Descriptive
		OP	LP	OLS		statistics
ln Employees	X_1	0.178***	0.176***	0.577***	Mean	271
		(0.057)	(0.049)	(0.010)	SD	1,188
ln Borrowed funds	X_2	0.405***	0.404***	0.526***	Mean	1,258
		(0.067)	(0.067)	(0.007)	SD	10,329
ln Fixed assets	K	0.209***	0.240***	-0.035***	Mean	15
		(0.051)	(0.032)	(0.007)	SD	56
Constant				-0.129***		
				(0.030)		
Dependent: Lending	Y				Mean	1,334
					SD	11,667

Notes: The sample comprises 12,569 observations for 2,439 banks between 2000 and 2006. All monetary volumes are in million euro. Employees are full-time equivalents. Borrowed funds are the sum of deposits and other debt liabilities. Time-fixed effects are included, but not reported. Standard errors in parantheses for the **?** (OP) and **?** (LP) estimation of parameters are bootstrapped. Robust standard errors for ordinary least squares (OLS) estimations.

Table 4
CAMEL profile and productivity by internationalization mode

	Domestic		International assets		Foreign branches		Subsidiaries		All banks	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Panel A: Productivity estimates										
OP	1.88	0.54	2.15	0.63	3.79	0.85	3.70	0.78	1.96	0.59
LP	11.78	25.63	19.66	33.99	115.53	60.76	112.29	61.6	13.56	28.13
MPL	0.27	0.12	0.25	0.10	0.08	0.10	0.06	0.06	0.27	0.11
Panel B: CAMEL covariates										
Capitalization	5.85	3.11	5.42	2.62	4.1	3.4	3.78	4.46	5.76	3.02
Cost-income ratio	44.1	9.17	41.07	10.56	25.65	14.69	26.23	12.09	43.45	9.58
Hidden reserves	1.41	1.04	1.34	1.05	0.17	0.29	0.16	0.24	1.39	1.04
Loan-loss provisions	5.4	7.83	5.17	10.61	2.94	4.2	2.54	2.88	5.35	8.46
Non-performing loans	0.96	1.21	0.97	1.03	0.81	0.86	0.66	0.61	0.96	1.18
Return on Equity	10.52	16.32	10.98	14.58	7.5	17.76	5.69	14.63	10.61	15.98

Notes: Descriptive statistics of parent bank-specific variables, measured in percentages except for productivity. Productivity descriptives in panel A pertain to 2,226 banks and 9,822 observations between 2002 and 2006 that are used to estimate Equations (8a) and (8b). The sample in panel B consists of 12,569 observations for 2,439 banks between 2000 and 2006. Parent banks are sorted by their mode of internationalization: Mode 1 (International assets), Mode 2a (Foreign branches), and Mode 2b (Branches and subsidiaries). OP denotes productivity estimates obtained as in **?**, LP indicates productivity as in **?**. *MPL* is labor productivity measured as full-time equivalents per million Euros of gross total assets of the parent bank. All variables are defined in Appendix B.

Table 5
Summary statistics of country-specific variables

	Unit	Mean	SD	Percentiles	
				1^{st}	99^{th}
Panel A: Exclusion restrictions					
WTO free trade	Score	0.258	0.438	0	1
Chinn-Ito capital account (CA) openess	Index	1.510	1.311	-1.169	2.439
CA equity	Score	0.437	0.496	0	1
CA money market	Score	0.437	0.496	0	1
CA bond market	Score	0.396	0.489	0	1
CA collective investment	Score	0.407	0.491	0	1
CA commercial banks	Score	0.360	0.480	0	1
CA FDI	Score	0.383	0.486	0	1
Panel B: country covariates					
Activity restrictions	Score	8.886	2.516	4.000	14.000
Capital restrictions	Score	5.486	1.556	2.000	8.000
Institutional quality	Score	3.529	0.513	2.183	4.500
Gross domestic product (GDP)	bn USD in logs	26.177	1.486	22.983	30.087
GDP per capita	tds USD in logs	9.271	1.283	6.183	10.793
German foreign direct investment (FDI)	bn EUR in logs	14.827	2.204	7.810	19.331
GDP growth correlation	%	0.407	0.474	-0.803	0.988
Volatility of foreign GDP	%	1.973	1.608	0.418	7.417
Distance	Kilometers	8.104	1.150	5.864	9.805
Banking market concentration	%	0.660	0.214	0.229	0.993
Offshore	0/1 indicator	0.057	0.232	0.000	1.000
Less developed country (LDC)	0/1 indicator	0.629	0.483	0.000	1.000
Financial center	0/1 indicator	0.057	0.232	0.000	1.000
Euro area	0/1 indicator	0.229	0.420	0.000	1.000

Notes: The sample comprises 343,770 bank-year-country observations pertaining to 35 countries from 2001 until 2006. The WTO free trade agreement indicator measures whether Germany (or equivalently) the European Union has either signed a free-trade agreement with the respective foreign country or whether the foreign country is a member state of the European Union. Data on the individual Capital Account (CA) restrictions and the index draw on **?**. All variables are defined in Appendix B.

Table 6
Baseline regression results extensive margin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Olley and Pakes (1996) productivity (OP) and exclusion restrictions					Alternative productivity	
	None	CAO index	WTO	Both	OP	LP	MPL
Productivity and selection							
Olley-Pakes (1996)	0.2831***	0.2800***	0.2813***	0.2773***	0.2787***		
productivity (OP)	(0.016)	(0.017)	(0.016)	(0.017)	(0.017)		
Levinsohn-Petrin (2003)						0.0021***	
productivity (LP)						(0.000)	
Labor productivity							0.1382***
(FTE/GTA) (MPL)							(0.313)
Chinn-Ito CA Index		0.0184***		0.0679***			
		(0.005)		(0.006)			
WTO free trade			0.3383***	0.4092***	0.3252***	0.3240***	0.3414***
			(0.021)	(0.023)	(0.022)	(0.022)	(0.022)
CA equity					0.3744***	0.3737***	0.3815***
					(0.025)	(0.025)	(0.025)
CA money market					-0.2157***	-0.2153***	-0.2174***
					(0.017)	(0.017)	(0.017)
CA bond market					-0.1076***	-0.1070***	-0.1083***
					(0.022)	(0.022)	(0.022)
CA collective investment					-0.0607***	-0.0601***	-0.0632***
					(0.015)	(0.015)	(0.015)
CA FDI					0.1769***	0.1748***	0.1832***
					(0.017)	(0.017)	(0.017)
Bank-specific covariates							
Size quintile indicator	0.3673***	0.3670***	0.3685***	0.3686***	0.3686***	0.4110***	-0.0157
	(0.006)	(0.006)	(0.006) (0.006)		(0.006)	(0.005)	(0.011)
Cost-Income Ratio	0.0025***	0.0022***	0.0026***	0.0023***	0.0023***	-0.0020**	-0.0210***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Return on Equity	0.0006*	0.0008**	0.0006*	0.0007**	0.0007*	0.0008**	0.0009**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capitalization	-0.0210***	-0.0207***	-0.0205***	-0.0202***	-0.0202***	-0.0228***	-0.0112***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Hidden Reserves	-0.0224***	-0.0224***	-0.0218***	-0.0218***	-0.0217***	-0.0260***	0.007
	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
Non-performing Loans	-0.0036	-0.0059	-0.0031	-0.0053	-0.0056	-0.005	-0.0307***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)	(0.006)
Loan-Loss Provisions	0.0007	0.0008	0.0005	0.0006	0.0007	-0.0002	0.0036***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
East Germany	-0.1637***	-0.1479***	-0.1635***	-0.1485***	-0.1481***	-0.2678***	-0.2814***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.019)	(0.019)

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Olley and Pakes (1996) productivity (OP) and exclusion restrictions					Alternative productivity	
	None	CAO index	WTO	Both	OP	LP	MPL
Country-specific covariates							
Activity restrictions	-0.0865***	-0.0596***	-0.0976***	-0.0779***	-0.0611***	-0.0612***	-0.0614***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Capital restrictions	-0.1093***	-0.0884***	-0.1178***	-0.0989***	-0.0971***	-0.0971***	-0.1006***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Institutional quality	0.0148	0.0924***	0.1259***	0.1953***	0.1673***	0.1675***	0.1748***
	(0.024)	(0.025)	(0.028)	(0.029)	(0.029)	(0.029)	(0.029)
Gross domestic	0.1968***	0.1375***	0.2220***	0.1693***	0.1766***	0.1768***	0.1791***
product (GDP)	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)	(0.011)
GDP per capita	0.1366***	0.0930***	0.0556***	-0.0024	0.0840***	0.0829***	0.0826***
	(0.015)	(0.015)	(0.017)	(0.016)	(0.016)	(0.016)	(0.016)
German foreign direct	0.2793***	0.3242***	0.2778***	0.3250***	0.3007***	0.2990***	0.3133***
investment (FDI)	(0.008)	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
GDP growth correlation	0.1251***	0.1002***	0.0439***	-0.0018	0.0157	0.0154	0.0151
	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Volatility of foreign GDP	-0.0750***	-0.0752***	-0.0920***	-0.0798***	-0.1007***	-0.1003***	-0.1037***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Distance	-0.3420***	-0.3452***	-0.3674***	-0.3685***	-0.4266***	-0.4256***	-0.4365***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Banking market	0.1340***	0.2586***	0.0025	0.1394***	-0.0196	-0.0201	-0.0157
concentration	(0.034)	(0.035)	(0.035)	(0.036)	(0.035)	(0.035)	(0.035)
Intercepts and fixed effects							
Offshore	-0.1430***	-0.2162***	-0.0441	-0.1364***	-0.0698*	-0.0700*	-0.0653*
	(0.034)	(0.036)	(0.035)	(0.038)	(0.038)	(0.038)	(0.038)
Less developed	-0.3958***	-0.3670***	-0.1706***	-0.1476***	-0.2617***	-0.2605***	-0.2577***
country (LDC)	(0.034)	(0.034)	(0.036)	(0.036)	(0.037)	(0.037)	(0.037)
Financial center	0.2985***	0.3513***	0.1002***	0.1520***	0.1691***	0.1671***	0.1982***
	(0.028)	(0.029)	(0.031)	(0.031)	(0.032)	(0.032)	(0.033)
Euro area	-0.4901***	-0.4305***	-0.4593***	-0.4164***	-0.3447***	-0.3446***	-0.3517***
	(0.017)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)
μ_1	8.7408***	8.1337***	8.7703***	8.2634***	8.2471***	7.5869***	8.8330***
	(0.201)	(0.205)	(0.204)	(0.206)	(0.213)	(0.209)	(0.212)
μ_2	12.3186***	11.7420***	12.3477***	11.8780***	11.8528***	11.1732***	12.6274***
	(0.209)	(0.213)	(0.212)	(0.214)	(0.221)	(0.218)	(0.222)
μ_3	12.7250***	12.1458***	12.7506***	12.2778***	12.2528***	11.5677***	13.0967***
	(0.214)	(0.218)	(0.217)	(0.219)	(0.225)	(0.222)	(0.228)
Pseudo-R^2	0.3993	0.4078	0.3971	0.406	0.4068	0.4047	0.4258

Notes: The sample comprises 343,770 bank-year-country observations in up to 35 countries between 2001 and 2006. Banking-group and time-fixed effects are included but not reported. Standard errors are clustered at the bank-country level. All variables are lagged by one period. The selection equation (extensive margin) is estimated as an ordered probit model. The dependent variable is the mode of foreign presence. OP denotes productivity obtained by the method proposed by Olley and Pakes (1996). LP denotes productivity obtained by the method of Levinsohn and Petrin (2003). MPL denotes labor productivity measured as full-time equivalents per million Euros of total assets. All variables are defined in Appendix B. ***Significant at 1% level. **Significant at 5% level. * Significant at 10% level.

Table 7
Coefficient estimates and elasticities per foreign activity mode

	(1)	(2)	(3)	(4)	(5)
	Coefficient	Elasticities per mode			
		0	1	2a	2b
Productivity and selection					
Olley-Pakes (1996)	0.2787***	-0.1669***	0.8118***	2.5653***	2.8096***
productivity (OP)	(0.017)	(0.010)	(0.049)	(0.152)	(0.171)
WTO free trade	0.3252***	-0.0265***	0.1287***	0.4067***	0.4454***
	(0.022)	(0.002)	(0.009)	(0.027)	(0.030)
CA equity	0.3744***	-0.0481***	0.2340***	0.7394***	0.8098***
	(0.025)	(0.003)	(0.015)	(0.050)	(0.054)
CA money market	-0.2157***	0.0277***	-0.1348***	-0.4259***	-0.4664***
	(0.017)	(0.002)	(0.011)	(0.034)	(0.037)
CA bond market	-0.1076***	0.0126***	-0.0614***	-0.1941***	-0.2126***
	(0.022)	(0.003)	(0.012)	(0.040)	(0.043)
CA collective investment	-0.0607***	0.0072***	-0.0351***	-0.1110***	-0.1216***
	(0.015)	(0.002)	(0.008)	(0.027)	(0.029)
CA FDI	0.1769***	-0.0197***	0.0959***	0.3029***	0.3317***
	(0.017)	(0.002)	(0.009)	(0.029)	(0.031)
Bank-specific covariates					
Size quintile indicator	0.3686***	-0.3391***	1.6494***	5.2118***	5.7082***
	(0.006)	(0.006)	(0.029)	(0.110)	(0.121)
Cost-Income Ratio	0.0023***	-0.0312***	0.1515***	0.4789***	0.5245***
	(0.001)	(0.011)	(0.055)	(0.174)	(0.192)
Return on Equity	0.0007*	-0.0023*	0.0110*	0.0346*	0.0379*
	(0.000)	(0.001)	(0.006)	(0.018)	(0.020)
Capitalization	-0.0202***	0.0356***	-0.1733***	-0.5475***	-0.5997***
	(0.003)	(0.005)	(0.026)	(0.081)	(0.088)
Hidden Reserves	-0.0217***	0.0092***	-0.0449***	-0.1420***	-0.1555***
	(0.006)	(0.002)	(0.012)	(0.037)	(0.040)
Non-performing Loans	-0.0056	0.0016	-0.0079	-0.0251	-0.0275
	(0.007)	(0.002)	(0.009)	(0.029)	(0.032)
Loan-Loss Provisions	0.0007	-0.0011	0.0052	0.0165	0.0181
	(0.001)	(0.001)	(0.006)	(0.018)	(0.019)
East Germany	-0.1481***	0.0042***	-0.0204***	-0.0645***	-0.0706***
	(0.020)	(0.001)	(0.003)	(0.009)	(0.010)

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	(1)	(2)	(3)	(4)	(5)
	Coefficient	Elasticities per mode			
		0	1	2a	2b
Country-specific covariates					
Activity restrictions	-0.0611***	0.1652***	-0.8035***	-2.5389***	-2.7807***
	(0.005)	(0.012)	(0.060)	(0.189)	(0.211)
Capital restrictions	-0.0971***	0.1592***	-0.7745***	-2.4473***	-2.6804***
	(0.004)	(0.007)	(0.035)	(0.113)	(0.127)
Institutional quality	0.1673***	-0.1819***	0.8850***	2.7965***	3.0629***
	(0.029)	(0.032)	(0.155)	(0.487)	(0.538)
Gross domestic	0.1766***	-1.4126***	6.8712***	21.7119***	23.7798***
product (GDP)	(0.011)	(0.092)	(0.437)	(1.346)	(1.566)
GDP per capita	0.0840***	-0.2390***	1.1625***	3.6733***	4.0232***
	(0.016)	(0.047)	(0.227)	(0.714)	(0.787)
German foreign	0.3007***	-1.3593***	6.6123***	20.8936***	22.8836***
direct investment (FDI)	(0.009)	(0.039)	(0.214)	(0.722)	(0.748)
GDP growth correlation	0.0157	-0.0020	0.0097	0.0306	0.0335
	(0.017)	(0.002)	(0.010)	(0.033)	(0.036)
Volatility of foreign GDP	-0.1007***	0.0617***	-0.3002***	-0.9486***	-1.0390***
	(0.004)	(0.003)	(0.012)	(0.040)	(0.044)
Distance	-0.4266***	1.0585***	-5.1489***	-16.2697***	-17.8193***
	(0.009)	(0.023)	(0.105)	(0.374)	(0.419)
Banking market	-0.0196	0.0039	-0.0192	-0.0605	-0.0663
concentration	(0.035)	(0.007)	(0.034)	(0.109)	(0.119)
Intercepts and fixed effects					
Offshore	-0.0698*	0.0013*	-0.0063*	-0.0199*	-0.0218*
	(0.038)	(0.001)	(0.003)	(0.011)	(0.012)
Less developed	-0.2617***	0.0509***	-0.2476***	-0.7824***	-0.8570***
country (LDC)	(0.037)	(0.007)	(0.035)	(0.109)	(0.121)
Financial center	0.1691***	-0.0031***	0.0152***	0.0482***	0.0527***
	(0.032)	(0.001)	(0.003)	(0.009)	(0.010)
Euro area	-0.3447***	0.0223***	-0.1087***	-0.3435***	-0.3762***
	(0.019)	(0.001)	(0.006)	(0.020)	(0.022)
μ_1	8.2471***				
	(0.213)				
μ_2	11.8528***				
	(0.221)				
μ_3	12.2528***				
	(0.225)				
(Pseudo-)R^2	0.4068				

Notes: The sample comprises 343,770 bank-year-country observations for the extensive margin and 91,108 observations for the intensive margin in up to 35 countries between 2001 and 2006. Banking-group and time-fixed effects are included but not reported. Standard errors are clustered at the bank-country level. All variables are lagged by one period. The selection equation (extensive margin) is estimated as an ordered probit model. The dependent variable is the mode of foreign presence. Productivity is obtained by the method proposed by Olley and Pakes (1996). All variables are defined in Appendix B ***Significant at 1% level. **Significant at 5% level. * Significant at 10% level.

Table 8
Foreign activity volume conditional on foreign presence

	(1)	(2)	(3)	(4)	(5)	(6)
	Foreign assets (FA) (log-level)		FA_{ijt}/GTA_{it} (ratio)		FA_{ijt}/TFA_{it}	
	Coefficient	Elasticity	Coefficient	Elasticity	Coefficient	Elasticity
Productivity and selection						
Correction term λ	2.858***	0.4102***	1.834***	3.0899***	5.038***	0.4417***
	(0.083)	(0.012)	(0.231)	(0.352)	(0.502)	(0.044)
Olley-Pakes (1996)	0.930***	0.4189***	0.036	0.1907	-0.243	-0.0669
productivity (OP)	(0.051)	(0.023)	(0.088)	(0.468)	(0.212)	(0.058)
Bank-specific covariates						
Size quintile indicator	0.940***	0.7034***	0.294***	2.5836***	-1.491***	-0.6816***
	(0.026)	(0.020)	(0.053)	(0.436)	(0.139)	(0.063)
Cost-Income Ratio	-0.055***	-0.4721***	-0.022***	-2.2729***	-0.028**	-0.1494**
	(0.003)	(0.024)	(0.004)	(0.361)	(0.013)	(0.068)
Return on Equity	-0.000	-0.0010	0.004*	0.0972*	-0.001	-0.0014
	(0.001)	(0.003)	(0.002)	(0.054)	(0.006)	(0.008)
Capitalization	-0.036***	-0.0413***	0.022	0.2977	-0.036	-0.0247
	(0.008)	(0.009)	(0.024)	(0.319)	(0.047)	(0.033)
Hidden Reserves	-0.062***	-0.0176***	-0.035***	-0.1156***	-0.041	-0.0071
	(0.018)	(0.005)	(0.012)	(0.039)	(0.088)	(0.015)
Non-performing Loans	-0.124***	-0.0250***	0.045	0.1056	-0.180	-0.0221
	(0.023)	(0.005)	(0.062)	(0.146)	(0.149)	(0.018)
Loan-Loss Provisions	0.013***	0.0137***	0.002	0.0300	0.003	0.0017
	(0.002)	(0.002)	(0.004)	(0.045)	(0.009)	(0.006)
East Germany	0.625***	0.0107***	-0.044	-0.0089	0.089	0.0009
	(0.070)	(0.001)	(0.065)	(0.013)	(0.311)	(0.003)

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	(1)	(2)	(3)	(4)	(5)	(6)
	Foreign assets (FA) (level)		FA_{ijt}/GTA_{it} (ratio)		FA_{ijt}/TFA_{it}	
	Coefficient	Elasticity	Coefficient	Elasticity	Coefficient	Elasticity
Country-specific covariates						
Activity restrictions	0.066***	0.1072***	-0.067***	-1.2733***	0.431***	0.4282***
	(0.013)	(0.021)	(0.012)	(0.211)	(0.056)	(0.055)
Capital restrictions	-0.019	-0.0218	-0.093***	-1.2636***	-0.539***	-0.3819***
	(0.014)	(0.016)	(0.016)	(0.222)	(0.067)	(0.047)
Institutional quality	0.487***	0.3849***	0.309***	2.8691***	8.079***	3.9034***
	(0.099)	(0.078)	(0.062)	(0.596)	(0.492)	(0.233)
Gross domestic	-0.996***	-5.6220***	0.029	1.8879	-4.310***	-14.8612***
product (GDP)	(0.038)	(0.214)	(0.028)	(1.812)	(0.181)	(0.608)
GDP per capita	0.793***	1.6680***	-0.015	-0.3633	-1.302***	-1.6725***
	(0.075)	(0.158)	(0.076)	(1.877)	(0.316)	(0.405)
German foreign direct	1.502***	5.1525***	0.511***	20.5554***	4.582***	9.6027***
investment (FDI)	(0.009)	(0.109)	(0.046)	(1.607)	(0.149)	(0.298)
GDP growth correlation	0.142**	0.0190**	0.079**	0.1242**	-0.607**	-0.0497**
	(0.060)	(0.008)	(0.040)	(0.063)	(0.239)	(0.020)
Volatility of foreign GDP	0.016	0.0047	-0.025	-0.0900	-0.317***	-0.0588***
	(0.020)	(0.006)	(0.027)	(0.096)	(0.082)	(0.015)
Distance	-0.078**	-0.1206**	-0.420***	-7.5948***	-0.737***	-0.6946***
	(0.031)	(0.048)	(0.052)	(0.832)	(0.140)	(0.132)
Banking market concentration	-2.673***	-0.3593***	-0.194***	-0.3052***	-8.909***	-0.7315***
	(0.133)	(0.018)	(0.065)	(0.104)	(0.574)	(0.047)
Intercepts and fixed effects						
Offshore	-1.678***	-0.0057***	-0.707***	-0.0280***	-7.301***	-0.0150***
	(0.148)	(0.000)	(0.122)	(0.004)	(0.537)	(0.001)
Less developed	-1.753***	-0.3273***	-0.181	-0.3968	-2.596***	-0.2960***
country (LDC)	(0.173)	(0.032)	(0.218)	(0.481)	(0.764)	(0.087)
Financial center	1.436***	0.0572***	0.098*	0.0459*	-0.345	-0.0084
	(0.069)	(0.003)	(0.052)	(0.024)	(0.299)	(0.007)
Euro area	2.012***	0.1333***	-0.221***	-0.1718***	6.514***	0.2636***
	(0.064)	(0.004)	(0.078)	(0.057)	(0.292)	(0.012)
Constant	-5.425***		-7.092***		47.506***	
	(1.018)		(1.548)		(4.740)	
(Pseudo-)R^2	0.357		0.231		0.384	

Notes: The sample comprises 343,770 bank-year-country observations for the extensive margin and 91,108 observations for the intensive margin in up to 35 countries between 2001 and 2006. Banking-group and time-fixed effects are included but not reported. Standard errors are clustered at the bank-country level. All variables are lagged by one period. The outcome equation (intensive margin) is estimated with OLS. The dependent variable is the log volume of international assets unless noted otherwise. GTA denotes gross total domestic assets, FA_{ijt} denotes foreign assets of bank i in country j, and TFA_{it} denotes total foreign assets of bank i aggregated across all countries j. Productivity is obtained by the method proposed by Olley and Pakes (1996). All variables are defined in Appendix B ***Significant at 1% level. **Significant at 5% level. * Significant at 10% level.

Table 9
Extensive and intensive margins of foreign activity per banking group

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Large banks		Commercials		Savings		Cooperatives	
	EM	IM	EM	IM	EM	IM	EM	IM
Productivity and selection								
Correction term		1.138***		2.434***		2.390***		4.278***
		(0.109)		(0.114)		(0.274)		(0.156)
Olley-Pakes (1996)	0.621***	1.648***	0.019	-0.087	0.729***	2.028***	0.630***	1.759***
productivity (OP)	(0.160)	(0.241)	(0.015)	(0.059)	(0.042)	(0.161)	(0.028)	(0.103)
WTO free trade	-0.037		0.325***		0.349***		0.325***	
	(0.218)		(0.067)		(0.042)		(0.029)	
CA equity	-0.264		0.014		0.226***		0.409***	
	(0.204)		(0.079)		(0.048)		(0.030)	
CA money market	-0.179		-0.064		-0.213***		-0.221***	
	(0.143)		(0.056)		(0.034)		(0.022)	
CA bond market	0.210		0.017		-0.050		-0.059**	
	(0.173)		(0.068)		(0.041)		(0.028)	
CA collective investment	0.086		-0.067		-0.020		-0.070***	
	(0.121)		(0.049)		(0.028)		(0.019)	
CA FDI	0.277*		0.156***		0.232***		0.187***	
	(0.156)		(0.051)		(0.031)		(0.022)	
Bank-specific covariates								
Size quintile indicator	1.198***	1.720***	1.147***	3.118***	0.607***	1.293***	0.562***	2.114***
	(0.145)	(0.174)	(0.040)	(0.150)	(0.023)	(0.107)	(0.017)	(0.068)
Cost-Income Ratio	0.077***	-0.004	0.008***	-0.037***	-0.017***	-0.071***	0.008***	-0.002
	(0.016)	(0.020)	(0.001)	(0.004)	(0.003)	(0.008)	(0.001)	(0.004)
Return on Equity	0.004	-0.010	0.002***	0.002	0.002*	0.002	0.003***	0.013***
	(0.004)	(0.006)	(0.000)	(0.002)	(0.001)	(0.003)	(0.001)	(0.002)
Capitalization	-0.055	-0.379***	-0.015***	-0.020**	-0.027**	-0.173***	-0.042***	-0.114***
	(0.065)	(0.090)	(0.002)	(0.008)	(0.012)	(0.035)	(0.006)	(0.020)
Hidden Reserves	-0.226	-0.180	0.008	0.332***	-0.012	0.121***	0.010	-0.037
	(0.243)	(0.311)	(0.026)	(0.077)	(0.009)	(0.028)	(0.009)	(0.025)
Non-performing Loans	-0.004	-0.180	-0.008	-0.123***	0.115***	0.120	0.092***	0.352***
	(0.105)	(0.144)	(0.005)	(0.025)	(0.025)	(0.073)	(0.012)	(0.037)
Loan-Loss Provisions	-0.054*	-0.106***	-0.000	0.009***	-0.028***	-0.039***	-0.016***	-0.084***
	(0.031)	(0.040)	(0.001)	(0.002)	(0.005)	(0.014)	(0.002)	(0.006)
East Germany	-0.315	-1.362***	-0.119	0.721**	0.302***	1.564***	-0.043	0.452***
	(0.213)	(0.282)	(0.085)	(0.307)	(0.044)	(0.147)	(0.031)	(0.097)

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Large banks		Commercials		Savings		Cooperatives	
	EM	IM	EM	IM	EM	IM	EM	IM
Country-specific covariates								
Activity restrictions	0.098**	0.181***	-0.024*	0.022	-0.095***	0.016	-0.048***	0.020
	(0.041)	(0.052)	(0.014)	(0.040)	(0.009)	(0.026)	(0.006)	(0.017)
Capital restrictions	0.014	0.117**	-0.010	0.071	-0.097***	-0.117***	-0.111***	-0.071***
	(0.046)	(0.054)	(0.014)	(0.043)	(0.008)	(0.026)	(0.005)	(0.020)
Institutional quality	0.402	-0.343	0.242***	-0.296	-0.179***	-0.224	0.322***	1.423***
	(0.291)	(0.358)	(0.091)	(0.300)	(0.055)	(0.175)	(0.040)	(0.125)
Gross domestic	-0.198	-0.482***	0.130***	-0.183	0.300***	-0.406***	0.114***	-1.505***
product (GDP)	(0.141)	(0.120)	(0.039)	(0.114)	(0.022)	(0.077)	(0.014)	(0.046)
GDP per capita	0.190	1.360***	0.072	0.485**	0.240***	1.560***	-0.010	0.690***
	(0.177)	(0.242)	(0.052)	(0.200)	(0.030)	(0.136)	(0.021)	(0.098)
German foreign direct	0.458***	0.875***	0.199***	0.820***	0.258***	1.046***	0.373***	2.320***
investment (FDI)	(0.086)	(0.092)	(0.026)	(0.082)	(0.017)	(0.059)	(0.013)	(0.050)
GDP growth	-0.000	-0.135	-0.210***	-0.310*	-0.195***	-0.608***	0.195***	1.051***
correlation	(0.116)	(0.191)	(0.047)	(0.172)	(0.029)	(0.101)	(0.024)	(0.076)
Volatility of	-0.013	-0.016	-0.048***	0.052	-0.065***	0.065**	-0.123***	-0.062**
foreign GDP	(0.030)	(0.053)	(0.011)	(0.050)	(0.007)	(0.030)	(0.006)	(0.030)
Distance	-0.069	-0.421***	-0.315***	-0.667***	-0.510***	-0.239***	-0.398***	0.025
	(0.071)	(0.099)	(0.025)	(0.093)	(0.016)	(0.077)	(0.011)	(0.043)
Banking market	0.230	-1.757***	-0.073	-2.302***	0.115*	-2.478***	0.004	-2.172***
concentration	(0.358)	(0.453)	(0.118)	(0.396)	(0.066)	(0.235)	(0.046)	(0.173)
Intercepts and cutoffs								
Offshore	0.631**	0.781	0.245**	-0.246	0.207***	-0.120	-0.384***	-3.645***
	(0.267)	(0.489)	(0.099)	(0.347)	(0.060)	(0.207)	(0.062)	(0.245)
Less developed	0.022	-0.275	-0.078	-0.326	-0.500***	-3.438***	-0.085*	-1.946***
country (LDC)	(0.339)	(0.490)	(0.111)	(0.457)	(0.066)	(0.309)	(0.049)	(0.229)
Financial center	0.744**	1.599***	0.107	1.584***	0.081	1.963***	0.233***	0.915***
	(0.305)	(0.324)	(0.105)	(0.267)	(0.068)	(0.122)	(0.042)	(0.083)
Euro area	-0.077	0.948***	0.111*	0.970***	-0.294***	2.121***	-0.454***	1.722***
	(0.207)	(0.206)	(0.063)	(0.213)	(0.037)	(0.115)	(0.025)	(0.085)
μ_1	7.737***		7.445***		9.999***		8.603***	
	(2.802)		(0.735)		(0.432)		(0.263)	
μ_2	11.762***		10.378***		14.814***		13.346***	
	(2.881)		(0.755)		(0.529)		(0.348)	
μ_3	12.714***		10.866***		14.979***			
	(2.928)		(0.746)		(0.558)			
Constant		-5.692**		-5.111**		-14.935***		-13.283***
		(2.763)		(2.583)		(2.416)		(1.633)
Observations	3,003	2,677	22,704	8,615	78,540	27,648	219,879	52,159
Pseudo-R^2	0.384		0.302		0.401		0.428	

Notes: The table shows results for the extensive margin and the intensive margin per banking group in up to 35 countries between 2001 and 2006. Time-fixed effects are included but not reported. Standard errors are clustered at the bank-country level. All variables are lagged by one period. The selection equation (extensive margin) is estimated as an ordered probit model. The dependent variable is the mode of foreign presence. The outcome equation (intensive margin) is estimated with OLS. The dependent variable is the log volume of international assets. Productivity is obtained by the method proposed by Olley and Pakes (1996). For further variable descriptions, see the Data Appendix. ***Significant at 1% level. **Significant at 5% level. * Significant at 10% level.

A. Deriving the correction term

To derive the correction term, we draw on the standard bivariate normality of error terms in equations that describe the extensive and intensive margins. The starting point is Equation (10):

$$E\left(IM_{ijt}|Z_{ijt}, EM_{ijt}=k\right) = \alpha X_{ijt} + \sigma_{IM} E\left(u_{ijt}|Z_{ijt}, EM_{ijt}=k\right), \tag{A.1}$$

where $k = 1, 2a, 2b$. We assume that the errors of the extensive and intensive margin are correlated. The conditional expectations of the error term $\sigma_{IM}E[u_{ijt}|Z_{ijt}, EM_{ijt} = 0]$ is then $\sigma_{IM}E[\rho v_{ijt}|Z_{ijt}, EM_{ijt} = 0]$. Further simplification of the conditioning part yields $\sigma_{IM}\rho E[v_{ijt}|\mu_k - \beta Z_{ijt} < v_{ijt} < \mu_{k+1} - \beta Z_{ijt}]$.

If we assume the error term follows a conditional standard normal distribution, we can explicitly write the conditional expectation

$$\sigma_{IM}\rho E\left(v_{ijt}|\mu_k - \beta Z_{ijt} < v_{ijt} < \mu_{k+1} - \beta Z_{ijt}k\right) \tag{A.2}$$

as:

$$\int_{\mu_k - \beta Z_{ijt}k}^{\mu_{k+1} - \beta Z_{ijt}k} v_{ijt} f\left(v_{ijt}|\mu_k - \beta Z_{ijt} < v_{ijt} < \mu_{k+1} - \beta Z_{ijt}k\right) dv_{ijt} \tag{A.3}$$

Rewriting the conditional expectation when applying the definition of a conditional density function yields a ratio of the density $\phi(v_{ijt})$ and the cumulative density function, such that we can rewrite Equation (A.1) as

$$\frac{1}{\Phi\left(\mu_{k+1} - \beta Z_{ijt}\right) - \Phi\left(\mu_k - \beta Z_{ijt}\right)} \int_{\mu_k - \beta Z_{ijt}k}^{\mu_{k+1} - \beta Z_{ijt}k} v_{ijt}\phi\left(v_{ijt}\right) dv_{ijt} \tag{A.4}$$

Now, it is possible to integrate and exploit the fact that $\phi'(v_{ijt}) = -v_{ijt}\phi(v_{ijt})$:

$$\frac{\phi\left(\mu_{k+1} - \beta Z_{ijt}\right) - \left(-\phi\left(\mu_k - \beta Z_{ijt}\right)\right)}{\Phi\left(\mu_{k+1} - \beta Z_{ijt}\right) - \Phi\left(\mu_k - \beta Z_{ijt}\right)} = \frac{\phi\left(\mu_k - \beta Z_{ijt}\right) - \phi\left(\mu_{k+1} - \beta Z_{ijt}\right)}{\Phi\left(\mu_{k+1} - \beta Z_{ijt}\right) - \Phi\left(\mu_k - \beta Z_{ijt}\right)} \tag{A.5}$$

In turn, we obtain three distinct correction terms (λ_{OP}^k) to address the selection bias. Their particular shape and conditionality on the realized modes (categories

0, 1, 2a, or 2b) of the extensive margin level distinguish our ordered probit model from **?** conventional selection equation. The conditional error term of the intensive margin $\sigma_{IM}E[\rho v_{ijt}|Z_{ijt}, EM_{ijt} = k]$ transforms into:

$$\sigma_{IM}\rho\lambda^{1}_{ijt} = \sigma_{IM}\rho\frac{\phi\left(\mu_1 - \beta Z_{ijt}\right) - \phi\left(\mu_{2a} - \beta Z_{ijt}\right)}{\Phi\left(\mu_{2a} - \beta Z_{ijt}\right) - \Phi\left(\mu_1 - \beta Z_{ijt}\right)} \qquad if\, EM_{ijt} = 1 \qquad \text{(A.6a)}$$

$$\sigma_{IM}\rho\lambda^{2a}_{ijt} = \sigma_{IM}\rho\frac{\phi\left(\mu_{2a} - \beta Z_{ijt}\right) - \phi\left(\mu_{2b} - \beta Z_{ijt}\right)}{\Phi\left(\mu_{2b} - \beta Z_{ijt}\right) - \Phi\left(\mu_{2a} - \beta Z_{ijt}\right)} \qquad if\, EM_{ijt} = 2a \qquad \text{(A.6b)}$$

$$\sigma_{IM}\rho\lambda^{2b}_{ijt} = \sigma_{IM}\rho\frac{\phi\left(\mu_{2b} - \beta Z_{ijt}\right)}{1 - \Phi\left(\mu_{2b} - \beta Z_{ijt}\right)} \qquad if\, EM_{ijt} = 2b \qquad \text{(A.6c)}$$

which results in the correction term. In the equation for the intensive margin, $\sigma_{EM}\rho$ becomes part of the coefficient to estimate, whereas the regressor λ^{k}_{ijt} carries information on the different cut-offs that characterize the extensive margin.

B. Data Appendix

B.1. Bank-Level variables

Bank data are from unconsolidated balance sheets, profit and loss accounts, and audit reports reported annually by all banks to the German central bank (*Deutsche Bundesbank*). The variables for both the productivity estimation and the CAMEL vector are corrected for outliers by truncating them at the 1^{st} and the 99^{th} percentiles. Level variables are deflated by the consumer price index. The various sources of country-specific variables are indicated for each variable described.

Banking groups Large banks represent the head institutions of the savings ('Landesbanken') and cooperative banks and the largest commercial banks. Commercial banks are privately owned but not necessarily publicly listed banks. Savings banks are (local) government-owned regional banks. Cooperative banks are mutually owned regional banks.

Borrowed funds Sum of deposits and other debt in million euros.

Capitalization Core Capital as a percentage of gross total assets.

Cost-to-income ratio Personnel expenditure as a percentage of total administrative cost. Employees are full-time equivalents.

Equity Gross total equity in million euros.

Fixed assets Physical capital including buildings and IT capital stock, in million euros.

Lending Total customer loans in million euros.

Loan-loss provisions Stock of loan-loss provisions as a percentage of gross total loans.

Non-performing loans Loans with latent risks according to central bank auditors as a percentage of total audited loans.

Productivity Empirical estimates are based on a bank production function in logs explaining total lending as a function of fixed assets, full time equivalent employees, and borrowed funds as production factors obtained with the estimators of **?** *OP* and **?** *LP*, respectively. Equity capital is specified in both approaches as intermediate input. Exit through mergers is specified in the former method. The third measure is observed labor productivity *MPL*, measured as FTE per million euros of gross total assets.

Reserves Hidden reserves according to §340f of the German commercial code as

a percentage of gross total assets.

Return on equity (ROE) Operating results, including net interest, fees, commissions, and trading income as a percentage of equity capital.

Size Following **?**, size is a quintile indicator based on the distribution of gross total assets across all parent banks per year.

Total assets Gross total assets in million euros.

B.2. Exclusion Restrictions

Data on the exclusion restrictions draw on two sources. The World Trade Organization (WTO) free trade agreement indicator is constructed from the register on regional trade agreements as provided by the WTO website. [18] Data on the Capital Account Openness indicator are from the most recent version of **?**.

WTO free trade Indicator of whether Germany (or the European Union) has signed a free trade agreement with the respective country.

Capital Account Openess Index by **?**, which captures the extent and intensity of capital controls. Loans and advances to banks, firms, governments, bonds and notes, foreign shares and other equity, participation abroad. Higher values indicate more open economies.

CA equity Controls on equity purchases, sales, issuances by residents and non-residents, or on inflow and outflow of equities. A value of "one" indicates more restrictions.

CA money Controls on money market purchases, sales, issuances by residents and non-residents, or on inflow and outflow of money market securities. A value of "one" indicates more restrictions.

CA bond Controls on bond purchases and sales and issuances by residents and non-residents, or on inflow and outflow of debt securities. A value of "one" indicates more restrictions.

CA collective investment Controls on collective investment purchases, sales, issuances by residents and non-residents. A value of "one" indicates more restrictions.

CA FDI Controls on foreign direct investment. A value of "one" indicates more restrictions.

[18] Available at http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx.

B.3. Country-level variables

Activity restrictions Indicates whether banks are restricted from engaging in securities underwriting, insurance underwriting and selling, real estate investments, management, and development. Higher values indicate tighter restrictions (Beck et al. 2006).

Concentration Fraction of total assets held by the three largest banks in the economy (World Bank).

Capital regulation Combined measure of overall and initial capital stringency, ranging from 0 to 9, with a higher value indicating greater stringency (Beck at el. 2006).

Developing country Indicator variable equal to "one" if the country is not a high-income country, according to the income taxonomy of the Worldbank (WDI, Worldbank).

Distance Geographic distance between Germany and host country j (CEPII).

Economic freedom Composite of 10 factors measuring institutional quality and policies pertaining to trade, government finances, government interventions, monetary policy, capital flows and foreign investment, banking and finance, wages and prices, property rights, regulation, and black market activity; higher values indicate better institutions (Beck et al. 2006).

FDI Aggregate volume of FDI in host country (Microdatabase Foreign Direct Investment (MiDi), Deutsche Bundesbank).

Financial center Indicator variable equal to "one" for Luxembourg, Switzerland, and the UK, including the channel islands, following the definition of the External Position Report (Deutsche Bundesbank).

GDP per capita Gross domestic product in million US dollar (2000 = 100).

GDP-growth correlations: Correlation of German and destination country GDP in the preceding five years.

Institutional quality Six dimensions of indices voice and accountability, government effectiveness, political stability, regulatory quality, rule of law, and control of corruption (Kaufman et al. 1999, Beck et al. 2006).

Offshore destination Indicator variable equal to "one" for Hong Kong, Singapore, and the Philippines, following the definition of the External Position Report (Deutsche Bundesbank).

Volatility Change of growth rate residuals, net of cyclical effects in the preceding five-year period.

Data about the international assets of German banks come from the External Position Report (Auslandsstatus) of the *Deutsche Bundesbank*. The data are confidential and can be used on the premises of the *Deutsche Bundesbank* only.

International assets Loans and advances to banks, companies, governments, bonds and notes, foreign shares and other equity, participation abroad, denominated or converted into euro.

Branches and subsidiaries Foreign affiliates of German parent banks. Branches do not enjoy independent legal status, whereas subsidiaries do. Assets held by affiliates are attributed to the country in which they are located.

Countries Australia, Austria, Belgium, Canada, Chile, Cyprus, Denmark, Egypt, Finland, France, Greece, India, Indonesia, Ireland, Israel, Italy, Japan, Jordan, Korea, Rep., Malaysia, Mexico, Netherlands, New Zealand, Panama, Peru, Philippines, Portugal, Singapore, South Africa, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States.